CLAIMS

1. A thin film transistor comprising: a semiconductor layer; and a source region and a drain region provided to be isolated from each other so as to mutually oppose the semiconductor layer, wherein

the semiconductor layer has π-conjugated organic semiconductor molecules as its main component; and

the π-conjugated organic semiconductor molecules are oriented so that π orbitals thereof substantially oppose each other and that a molecular axis of main chains thereof is oriented to be inclined with respect to a direction of electric field in a channel formed in the semiconductor layer.

2. The thin film transistor according to claim 1, wherein:

the source region and the drain region are provided to be isolated from each other so as to have mutually opposing sides facing the semiconductor layer; and

the π-conjugated organic semiconductor molecules are oriented so that the molecular axis of the main chains is inclined with respect to a direction perpendicular to the opposing sides.

3. The thin film transistor according to claim 1, wherein:

the source region and the drain region are provided to be isolated from each other so as to have mutually opposing planes facing the semiconductor layer; and

the π-conjugated organic semiconductor molecules are oriented so that the molecular axis of the main chains is inclined with respect to a direction

perpendicular to the opposing planes.

4. The thin film transistor according to claim 2 or 3, further comprising:

a gate electrode provided on at least one surface of the semiconductor layer with a gate insulating layer interposed therebetween; and

the molecular axis of the main chains of the π-conjugated organic semiconductor molecules is oriented substantially in an orientation direction that is inclined at an angle θ with respect to the direction perpendicular to the opposing sides or opposing planes of the source region and the drain region, the angle θ determined by the following equation (1):

$$\theta = \arctan(\sigma 2/\sigma 1), \qquad (1)$$

where σ1 is a conductivity along the molecular axis direction of the main chains of the π-conjugated organic semiconductor molecules and σ2 is a conductivity along the direction perpendicular to the molecular axis direction and along the π orbital axis direction, the conductivities being determined in a state in which a voltage substantially equivalent to that when the thin film transistor is ON is applied to the gate electrode.

5. The thin film transistor according to claim 4, wherein the molecular axis of the main chains of the π-conjugated organic semiconductor molecules is oriented so as to exist within a plane substantially parallel to a principal plane of the semiconductor layer, and a range of the orientation is the angle θ ±10°.

6. The thin film transistor according to claim 4, wherein the molecular

axis of the main chains of the π-conjugated organic semiconductor molecules is oriented so as not to exist within a plane substantially parallel to a principal plane of the semiconductor layer, and a range of the orientation is the angle θ ±5°.

7. The thin film transistor according to claim 1, wherein the π-conjugated organic semiconductor molecules are made of a derivative having as its main chain a molecular structure of one of thiophene, acetylene, pyrrole, phenylene, and acene, or combinations thereof.

8. The thin film transistor according to claim 7, wherein the π orbitals do not extend from the π-conjugated organic semiconductor molecules in the same vector direction.

9. The thin film transistor according to claim 7 or 8, wherein the π-conjugated organic semiconductor molecules are crystalline.

10. A method of fabricating a thin film transistor having a semiconductor layer, and a source region and a drain region provided to be isolated from each other so as to mutually oppose the semiconductor layer, the method comprising:

using π-conjugated organic semiconductor molecules for the semiconductor layer as its main component; and

orienting the π-conjugated organic semiconductor molecules so that π orbitals substantially oppose each other, and that a molecular axis of main

chains thereof is oriented to be inclined with respect to a direction of electric field in a channel formed in the semiconductor layer.

11. The method of fabricating a thin film transistor according to claim 10, further comprising:

providing the source region and the drain region to be isolated from each other so as to have mutually opposing sides facing the semiconductor layer; and

orienting the π-conjugated organic semiconductor molecules so that the molecular axis of the main chains is inclined with respect to a direction perpendicular to the opposing sides.

12. The method of fabricating a thin film transistor according to claim 10, further comprising:

providing the source region and the drain region to be isolated from each other so as to have mutually opposing planes facing the semiconductor layer; and

orienting the π-conjugated organic semiconductor molecules so that the molecular axis of the main chains is inclined with respect to a direction perpendicular to the opposing planes.

13. The method of fabricating a thin film transistor according to claim 11 or 12, further comprising:

providing a gate electrode on at least one surface of the semiconductor layer with a gate insulating layer interposed therebetween; and

orienting the molecular axis of the main chains of the π-conjugated organic semiconductor molecules substantially in an orientation direction inclined at an angle θ with respect to the direction perpendicular to the opposing sides or opposing planes of the source region and the drain region, the angle θ determined by the following equation (1):

$$\theta = \arctan (\sigma 2/\sigma 1), \quad (1)$$

where σ1 is a conductivity along the molecular axis direction of the main chains of the π-conjugated organic semiconductor molecules and σ2 is a conductivity along the direction perpendicular to the molecular axis direction and along the π orbital axis direction, the conductivities being determined in a state in which a voltage substantially equivalent to that when the thin film transistor is on is applied to the gate electrode.

14. The method of fabricating a thin film transistor according to claim 13, further comprising: orienting the molecular axis of the main chains of the π-conjugated organic semiconductor molecules so as to exist within a plane substantially parallel to the principal plane of the semiconductor layer, and setting a range of the orientation to be the angle θ ±10°.

15. The method of fabricating a thin film transistor according to claim 13, further comprising: orienting the molecular axis of the main chains of the π-conjugated organic semiconductor molecules so as not to exist within a plane substantially parallel to the principal plane of the semiconductor layer, and setting a range of the orientation to be the angle θ ±5°.

16. The method of fabricating a thin film transistor according to claim 10, wherein a derivative having as its main chain a molecular structure of one of thiophene, acetylene, pyrrole, phenylene, and acene, or combinations thereof, is used as the π-conjugated organic semiconductor molecules.

17. An active matrix-type display comprising a plurality of thin film transistors according to any one of claims 1 through 9, as switching elements for driving pixels.

18. A wireless ID tag comprising a thin film transistor according to any one of claims 1 through 9 as a semiconductor element for constructing an integrated circuit.

19. A portable device comprising a thin film transistor according to any one of claims 1 through 9 as a semiconductor element for constructing an integrated circuit.